You are provided with EEG data recorded from 60 channels for 700 timepoints across 80 trials during a face.vs.car categorization task. Each timepoint represents one millisecond of EEG activity. Stimulus presentation starts at the 100th ms and lasts for 50ms, so the first 99ms of each trial are pre-stimulus EEG recordings. You are also provided with a 1x80 vector indicating which stimulus was presented on each trial (0=face, 1=car).

Your aim is to use the EEG signals to a) characterise neural responses during this experiment and b) decode which stimulus was presented on each trial. You will do that using the attached Matlab code which implements Linear Discriminant Analysis with Leave-One-Out cross-validation.

**A)** 1. Apply PCA to the data to identify EEG channels that covary. How many PCs do you think are needed to describe this dataset?

*Hint*: Use the pca.m function in Matlab. Use the reshape Matlab function to reshape the data you input to pca.m. Use the outputs of pca.m to inform your choice of number of components.

2. Plot a) the first 2 PCs (coeffs) and b) their trial-averaged activations (scores) for each one of the 2 stimuli. Do they allow discrimination of the 2 stimuli and at which time windows?

**B)** 1. Use the single\_trial\_analysis.m Matlab function to compute EEG classification performance (measured by the area under the ROC curve) Az in the time windows [201,250]ms and [451,500]ms.

*Hint*: Use the reshape Matlab function to reshape the data you input to single\_trial\_analysis.m.

2. Plot an Az curve across time to illustrate how stimulus classification evolves over the duration of a 700ms trial. How long after stimulus presentation do we get the best stimulus classification from the EEG signals? What happens if you change the duration of the time window?

*Hint*: Create a for loop to slide your temporal window across the 700 timepoints and compute Az in each instance of the sliding window. Then, vary the duration of the window and observe differences in the Az curve.

3. Compute the same curve without leave-one-out cross-validation (skipLOO=1). Observe the differences between the 2 curves focusing on the pre-stimulus Az values and comment on the role of cross-validation in classification analysis.